

3GPP2 S.R0005-B

Version Date: 16 April 2001

Version: 1.0



3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

Network Reference Model for cdma2000 Spread Spectrum Systems

Revision: B

COPYRIGHT

3GPP2 and its Organizational Partners claim copyright in this document and individual Organizational Partners may copyright and issue documents or standards publications in individual Organizational Partner's name based on this document. Requests for reproduction of this document should be directed to the 3GPP2 Secretariat at secretariat@3gpp2.org. Requests to reproduce individual Organizational Partner's documents should be directed to that Organizational Partner. See www.3gpp2.org for more information.

CONTENTS

CONTENTS	ii
LIST OF FIGURES	iii
PREFACE.....	iii
REVISION HISTORY	iv
1. PURPOSE AND SCOPE.....	5
1.1 References	5
2. REFERENCE MODELS	7
2.1 3GPP2 Wireless Network Reference Model.....	7
2.1.1 Network Entities	10
2.1.2 Reference Points	18

LIST OF FIGURES

Figure 2.1 3GPP2 Wireless Network Reference Model.....3

PREFACE

This 3GPP2 Wireless Network Reference Model depicts circuit-mode and packet mode operations.

REVISION HISTORY

Revision	Date	Description
0	June 1999	Initial publication
A	December 1999	<ul style="list-style-type: none"> • Update OAM&P elements to agree with PN-4108 • Added packet data network elements, rearranged several network elements • updated ME&MS elements to agree with definitions in PN-4582
B	March 2000	<ul style="list-style-type: none"> • Recommended changes from TR45 NAG added • Added PCF • Added HA • Add PN4463 Changes • Corrected U_v label on fig 2.1

1. PURPOSE AND SCOPE

This document recommends the basic 3GPP2 Wireless Network Reference Model.

1.1 References

ANSI-41

- TIA/EIA-41-D, *Cellular Radiotelecommunications Intersystem Operations*, December, 1997.

ANSI-95

- TIA/EIA/95, *Mobile Station – Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems*; Telecommunications Industry Association; May 1995.
- TSB74, *Support for 14.4 kbps Data Rates and PCS Interaction for Wideband Spread Spectrum Cellular Systems*, December, 1995.

ANSI-124

- TIA/EIA/124-C, *Wireless Radio Telecommunications Intersystem Non-Signaling Data Communications (DMH) Data Message Handler*; Telecommunications Industry Association; September 2000.

ANSI-136

- TIA/EIA/136B *TDMA Third Generation Wireless Revision B*. March 2000

ANSI-553

- EIA/TIA/553, *Mobile Station - Land Station Compatibility Specification*; November 1999.

IS-634

- TIA/EIA/634-B, *MSC - BS Interface for Public Wireless Communications Systems*, April 1999.

IS-658

- TIA/EIA/IS-658, *Data Services Interworking Function Interface for Wideband Spread Spectrum Systems*, July 1996.
- TIA/EIA/IS-658-1, *Data Services Interworking Function Interface for Wideband Spread Spectrum Systems – Addendum 1*, April 1999.

IS-683

- TIA/EIA/IS-683-A, *Over-The-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems*, June 1998.

IS-725

- TIA/EIA/IS-725-A, *Cellular Radiotelecommunications Intersystem Operations - Over-The-Air Service Provisioning (OTASP) & Parameter Administration (OTAPA)*, July 1999.

IS-728

- TIA/EIA/IS-728, *Intersystem Link Protocol*, April 1998

IS-737

- TIA/EIA/IS-737, *IS-41-C Enhancements to Support Circuit Mode Services*, May 1998.

IS-756

- TIA/EIA/IS-756-A TIA/EIA41-D *Enhancements for Wireless Number Portability Phase II*, December 1998

IS-771

- TIA/EIA/IS-771, *Wireless Intelligent Network*, July 1999

IS-788

- TIA/EIA/IS-788, *Connector Specification for the Portable Phone Interface*, June 1999

IS-789

- TIA/EIA/IS-789-A, *Electrical Specification for the Portable Phone to Vehicle Interface*, April 2000

IS-816

- TIA/EIA/IS-816, *IDB Message Set Definitions for the Electrical Interface Between Portable Phone and Vehicle*, tbd 2000

IS-820

- TIA/EIA/IS-820 *Removable User Identity Module (R-UIM) for TIA/EIA Spread Spectrum Standards*, March 2000

IS-826

- TIA/EIA/IS-823 *Wireless Intelligent Network Capabilities for Pre-Paid Charging*, August 2000

IS-835

- TIA/EIA/IS-835 *CDMA Wireless IP Network Standard*, December 2000

IS-841

- TIA/EIA/IS-841, *Network Based Enhancements for the User Identity Module (UIM)*, August 2000

IS-2000

- TIA/EIA/IS-2000-A cdma2000 Series, March 2000 which includes:
 - TIA/EIA/IS-2000.1-A *Introduction for cdma2000 Spread Spectrum Systems*
 - TIA/EIA/IS-2000.2-A, *Physical Layer Standard for cdma2000 Spread Spectrum System.*
 - TIA/EIA/IS-2000.3-A *Medium Access Control (MAC) Standard for Spread Spectrum Systems*
 - TIA/EIA/IS-2000.4-A *Link Access Control (LAC) Standard for Spread Spectrum Systems*

- TIA/EIA/IS-2000.5-A *Upper Layer (Layer 3) Signaling Standard for Spread Spectrum Systems*
- TIA/EIA/IS-2000.6-A *Analog Signaling Standard for Spread Spectrum Systems*

IS-2001

- TIA/EIA/IS-2001, *Access Network Interfaces Interoperability Specification (IOS)*, December 2000

ITU

- M.3100 *Generic Network Information Model*, July 1995

J-STD-025

- TIA/EIA/J-STD-025, *Lawfully Authorized Electronic Surveillance*, 2000

J-STD-036

- TIA/EIA/J-STD-036, *Wireless Enhanced Emergency Services*, 2000

2. REFERENCE MODELS

Reference models are a graphical tool used to visualize, structure, and describe certain complex subjects. A few such models are widely used in the 3GPP2 wireless recommendations.

2.1 3GPP2 Wireless Network Reference Model

Figure 2.1 presents the network entities and associated reference points that comprise a wireless network. The network entities are represented by squares, triangles and rounded corner rectangles; the reference points are represented by circles. The network reference model in this document is the compilation of several reference models currently in use in 3GPP2 wireless recommendations.

Note the following:

- **The network reference model is a functional block diagram.**
- **A network entity represents a group of functions, not a physical device. For example, a Mobile Switching Center (MSC) is a physical device; it comprises frames, shelves, circuit packs, etc. The physical device may comprise a single network entity such as the MSC, or it may comprise some combination such as the MSC, the Visitor Location Register (VLR), the Home Location Register (HLR), and the Authentication Center (AC). The physical realization is an implementation issue; a manufacturer may**

choose any physical implementation of network entities, either individually or in combination, as long as the implementation meets the functional requirements. Sometimes, for practical reasons, the functional network entity is a physical device. The Mobile Station (MS) is an excellent example.

- **A reference point is a conceptual point that divides two groups of functions. It is not necessarily a physical interface. A reference point only becomes a physical interface when the network entities on either side of it are contained in different physical devices.**
- **A “Collective Entity” contains encompassed network entities that are an instance of the collective.**
- **A “Composite Entity” contains encompassed network entities that are part of the composite.**

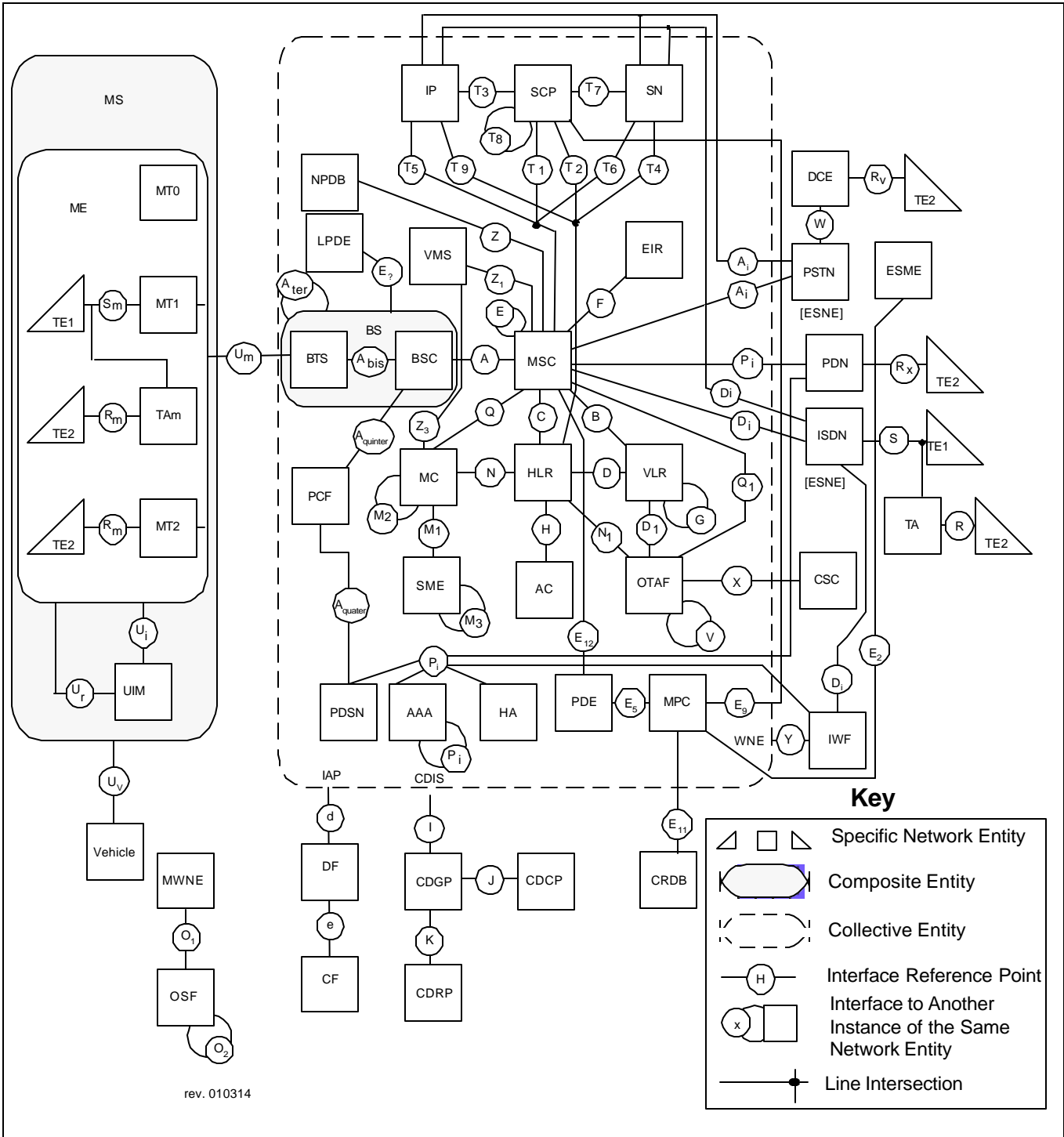


Figure 2.1 3GPP2 Wireless Network Reference Model

AAA	Authentication, Authorization, and Accounting	ME	Mobile Equipment
AC	Authentication Center	MPC	Mobile Position Center
BS	Base Station	MS	Mobile Station
BSC	Base Station Controller	MSC	Mobile Switching Center
BTS	Base Transceiver System	MT	Mobile Terminal
CDCP	Call Data Collection Point	MWNE	Managed Wireless Network Entity
CDGP	Call Data Generation Point	NPDB	Number Portability Data Base
CDIS	Call Data Information Source	OSF	Operations System Function
CDRP	Call Data Rating Point	OTAF	Over-The-Air Service Provisioning Function
CF	Collection Function	PCF	Packet Control Function
CRDB	Coordinate Routing Data Base	PDE	Position Determining Entity
CSC	Customer Service Center	PDN	Packet Data Network
DCE	Data Circuit Equipment	PDSN	Packet Data Serving Node
DF	Delivery Function	PSTN	Public Switched Telephone Network
EIR	Equipment Identity Register	SCP	Service Control Point
ESME	Emergency Services Message Entity	SN	Service Node
ESNE	Emergency Services Network Entity	SME	Short Message Entity
HA	Home Agent	TA	Terminal Adapter
HLR	Home Location Register	TE	Terminal Equipment
ISDN	Integrated Services Digital Network	UIM	User Identity Module
IP	Intelligent Peripheral	VLR	Visitor Location Register
IAP	Intercept Access Point	VMS	Voice Message Center
IWF	Interworking Function	WNE	Wireless Network Entity
LPDE	Local Position Determining Entity		
MC	Message Center		

2.1.1 Network Entities

Each Network Entity may be a physical device, it may form part of a physical device, or it may be distributed over a number of physical devices. See section 2.1.2 for the definition of the reference points associated with each network entity.

Authentication, Authorization and Accounting (AAA)

The AAA is an entity that provides Internet Protocol functionality to support the functions of Authentication, Authorization, and Accounting.

Authentication Center (AC)

The AC is an entity that manages the authentication information related to the MS. The AC may, or may not be located within, and be indistinguishable from an HLR. An AC may serve more than one HLR.

Base Station (BS)

A BS is an entity that provides the means for MSs to access network services using radio. It includes a BSC and a BTS.

Base Station Controller (BSC)

The BSC is an entity that provides control and management for one or more BTSs. The BSC exchanges messages with both the BTS and the MSC. Traffic and signaling concerned with call control, mobility management, and MS management may pass transparently through the BSC.

Base Transceiver System (BTS)

The BTS is an entity that provides transmission capabilities across the U_m reference point. The BTS consists of radio devices, antenna and equipment.

Call Data Collection Point (CDCP)

The CDCP is the entity that collects the *ANSI-124* format call detail information.

Call Data Generation Point (CDGP)

The CDGP is an entity that provides call detail information to the CDCP in *ANSI-124* format. This may be the entity which converts call detail information from a proprietary format into the *ANSI-124* format. All information from the CDGP to the CDCP must be in *ANSI-124* format.

Call Data Information Source (CDIS)

The CDIS is an entity that can be the source of call detail information. This information may be in proprietary format. It is not required to be in *ANSI-124* format.

Call Data Rating Point (CDRP)

The CDRP is the entity that takes the unrated *ANSI-124* format call detail information and applies the applicable charge and tax related information. The charge and tax information is added using *ANSI-124* format.

Collection Function (CF) - [Intercept]

The CF is an entity that is responsible for collecting intercepted communications for a lawfully authorized law enforcement agency.

The CFs typically include:

- the ability to receive and process call contents information for each intercept subject.
- the ability to receive information regarding each intercept subject (e.g., call associated or non-call associated) from the Delivery function and process it.

Coordinate Routing Data Base (CRDB)

The CRDB is an entity that stores information to translate a given position expressed as a latitude and longitude to a string of digits.

Customer Service Center (CSC)

The CSC is an entity where service provider representatives receive telephone calls from customers wishing to subscribe to initial wireless service or request a change in the customer's existing service. The CSC interfaces proprietarily with the OTAF to perform network and MS related changes necessary to complete the service-provisioning request.

Data Circuit Equipment (DCE)

A termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Delivery Function (DF) - [Intercept]

The DF is an entity that is responsible for delivering intercepted communications to one or more collection functions.

The DFs typically include:

- the ability to accept call contents for each intercept subject over one or more channels from each Access function.
- the ability to deliver call contents for each intercept subject over one or more channels to a Collection Function as authorized for each law enforcement agency.
- the ability to accept information over one or more data channels and combine that information into a single data flow for each intercept subject.
- the ability to filter or select information on an intercept subject before delivery to a Collection Function as authorized for a particular law enforcement agency.
- the optional ability to detect audio in-band DTMF digits for translation and delivery to a Collection Function as authorized for a particular law enforcement agency.
- the ability to duplicate and deliver information on the intercept subject to one or more Collection Functions as authorized for each law enforcement agency.
- the ability to provide security to restrict access.

Emergency Service Message Entity (ESME)

The ESME routes and processes the out of band messages related to emergency calls. This may be incorporated into selective routers (also known as Routing, Bridging, and Transfer Switches), public safety answering ports, emergency response agencies, and Automatic Location Information (ALI) database engines. The structure of the Emergency Service Network is beyond the scope of this specification. See J-STD-036.

Emergency Service Network Entity (ESNE)

The ESNE routes and processes the voice band portions of the emergency calls. This is composed of selective routers (also known as Routing, Bridging, and Transfer Switches), public safety answering points and emergency agencies. The structure of the Emergency Services Network is beyond the scope of this specification.

Equipment Identity Register (EIR)

The EIR is an entity that is the register to which user equipment identity may be assigned for record purposes. The nature, purpose, and utilization of this information are areas for further study.

Home Agent (HA)

The HA is an entity that:

- Authenticates Mobile IP registrations from the mobile station.
- Redirects packets to the foreign agent component of the PDSN, and optionally receive and route reverse packets from the Foreign Agent component of the PDSN.
- May establish, maintain and terminate secure communications to the PDSN.
- Receives provisioning information from the AAA function for users.
- May assign a dynamic home IP address.

Home Location Register (HLR)

The HLR is the location register to which a user identity is assigned for record purposes such as subscriber information (e.g. Electronic Serial Number (ESN), Mobile Directory Number (MDN), Profile Information, Current Location, Authorization Period).

Integrated Services Digital Network (ISDN)

The ISDN is defined in accordance with the appropriate *ANSI T1* Standards.

Intelligent Peripheral (IP)

The IP is an entity that performs specialized resource functions such as playing announcements, collecting digits, performing speech-to-text or text-to-speech conversion, recording and storing voice messages, facsimile services, data services, etc.

Intercept Access Point (IAP)

The IAP is an entity that provides access to the communications to or from, the equipment, facilities, or services of an intercept subject.

Interworking Function (IWF)

The IWF is an entity that provides information conversion for one or more WNEs. An IWF may have an interface to a single WNE providing conversion services. An IWF may augment an identified interface between two WNEs, providing conversion services to both WNEs.

Local Position Determining Entity (LPDE)

The LPDE facilitates the determination of the position or geographical location of a wireless terminal. Each LPDE supports one or more position determining technologies. Multiple LPDEs using the same technology may serve the coverage area of a Mobile Position Center (MPC) and the multiple LPDEs each using a different technology may serve the same coverage area of an MPC. Local PDEs (LPDEs) reside at the BS. See J-STD-036 for details regarding LPDE.

Managed Wireless Network Entity (MWNE)

A MWNE within the Collective Entity or any specific network entity that has OS wireless management needs, including another OS.

Message Center (MC)

The MC is an entity that stores and forwards short messages. The MC may also provide supplementary services for Short Message Service (SMS).

Mobile Equipment (ME)

The ME is the MS without a UIM. The ME is only capable of accessing the network per locally defined service configuration e.g. emergency services, service center, etc.

Mobile Position Center (MPC)

The MPC selects a PDE to determine the position of a mobile station. The MPC may restrict access to position information e.g. require that the MS be engaged in an emergency call or only release position information to authorized network entities.

Mobile Station (MS)

A wireless terminal used by subscribers to access network services over a radio interface. MSs include portable units (e.g., hand-held units), units installed in vehicles, and somewhat paradoxically, fixed location MSs. The MS is the interface equipment used to terminate the radio path at the subscriber. An MS is an ME with a programmed UIM.

Mobile Switching Center (MSC)

The MSC switches circuit mode MS originated or MS terminated traffic. An MSC is usually connected to at least one BS. It may connect to the other public networks (PSTN, ISDN, etc.), other MSCs in the same network, or MSCs in different networks. The MSC may store information to support these capabilities.

Mobile Terminal 0 (MT0)

A self-contained data capable ME termination that does not support an external interface.

Mobile Terminal 1 (MT1)

An ME termination that provides an ISDN user-network interface.

Mobile Terminal 2 (MT2)

An ME termination that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

Number Portability Data Base (NPDB)

The NPDB is an entity that provides portability information for portable Directory Numbers.

Operations Systems Function (OSF)

The OSF is defined by the Telecommunications Management Network (TMN) OSF (see ITU M.3100). These functions include Element Management Layer (EML), Network Management Layer (NML), Service Management Layer (SML), and Business Management Layer (BML) functions spanning across all operations systems functions (e.g., Fault Management, Performance Management, Configuration Management, Accounting Management and Security Management).

Over-The-Air Service Provisioning Function (OTAF)

The OTAF is an entity that interfaces proprietarily to CSCs to support service-provisioning activities. The OTAF interfaces with the MSC to send MS orders necessary to complete service provisioning requests.

Packet Control Function (PCF)

The Packet Control Function is an entity in the radio access network that manages the relay of packets between the BSC and the PDSN.

Packet Data Network (PDN)

A PDN, such as the Internet, provides a packet data transport mechanism between processing network entities capable of using such services.

Packet Data Serving Node (PDSN)

The PDSN routes MS originated or MS terminated packet data traffic. A PDSN establishes, maintains and terminates link layer sessions to Mobile Stations. A PDSN may interface to one or more Base Stations and may interface to one or more PDNs.

Position Determining Entity (PDE)

A PDE facilitates determination of the position or geographical location of an MS. Each PDE supports one or more position determining technologies. Multiple PDEs using the same technology may serve the coverage area of a Mobile Position Center (MPC) and the multiple PDEs each using a different technology may serve the same coverage area of an MPC.

Public Switched Telephone Network (PSTN)

The PSTN is defined in accordance with the appropriate *ANSI T1* Standards.

Service Control Point (SCP)

The SCP is an entity that acts as a real-time database and transaction processing system that provides service control and service data functionality.

Service Node (SN)

The SN is an entity that provides service control, service data, specialized resources and call control functions to support bearer-related services.

Short Message Entity (SME)

The SME is an entity that composes and decomposes short messages. A SME may, or may not be located within, and be indistinguishable from, an HLR, MC, VLR, MS, or MSC.

Terminal Adapter (TA)

An entity that converts signaling and user data between a non-ISDN and an ISDN interface.

Terminal Adapter m (TAm)

An entity that converts signaling and user data between a non-ISDN and an ISDN interface.

Terminal Equipment 1 (TE1)

A data terminal that provides an ISDN user-network interface.

Terminal Equipment 2 (TE2)

A data terminal that provides a non-ISDN user-network interface (e.g., ITU-T [CCITT] V series, ITU-T [CCITT] X series).

User Identity Module (UIM)

The UIM contains subscription information such as the NAM and may contain subscription feature information. The UIM can be integrated into any mobile equipment or it may be removable.

Vehicle

A vehicle is an entity in which the MS may be installed. The vehicle may provide power, audio, antenna connections to the MS along with control and user data gateway to vehicle based networks.

Visitor Location Register (VLR)

The VLR is the location register other than the HLR used by an MSC to retrieve information for handling of calls to or from a visiting subscriber. The VLR may, or may not be located within, and be indistinguishable from an MSC. The VLR may serve more than one MSC.

Voice Message System (VMS)

A VMS stores received voice messages, data messages e.g. email, or both message types and supports a method to retrieve previously stored messages. A VMS may also support (on a Directory Number basis) notification of the presence of stored messages and notification of a change in the number of voice messages, data messages, or both message types that are waiting retrieval.

Wireless Network Entity (WNE)

A Network Entity in the wireless Collective Entity.

2.1.2 Reference Points

The U_m reference point is the only reference point that is by definition a physical interface. The other reference points are physical interfaces if network entities on either side of them are contained in different physical devices.

An interface exists when two Network Entities are interconnected through exactly one Reference Point.

Reference Point A

Reference Point A is the interface between the BSC and the MSC.

Reference Point A_i

Reference Point A_i is the interface between the IP and the PSTN, plus the interface between the MSC and the PSTN [ESNE], plus the interface between the SN and the PSTN.

Reference Point A_{bis}

Reference Point A_{bis} is the interface between the BSC and the BTS.

Reference Point A_{ter}

Reference Point A_{ter} is the BS to BS interface.

Reference Point A_{quater}

Reference Point A_{quater} is the interface between the PDSN and the PCF.

Reference Point A_{quinter}

Reference Point A_{quinter} is the interface between the PCF and the BSC.

Reference Point B

Reference Point B is the interface between the MSC and the VLR.

Reference Point C

Reference Point C is the interface between the MSC and the HLR.

Reference Point D

Reference Point D is the interface between the VLR and the HLR.

Reference Point d

Reference Point d is the interface between an IAP and the DF.

Reference Point D₁

Reference Point D₁ is the interface between the OTAF and the VLR.

Reference Point D_i

Reference Point D_i is the interface between:

- the IP and the ISDN.
- the IWF and the ISDN.
- the MSC and the ISDN [ESNE].
- the SN and the ISDN..

Reference Point E

Reference Point E is the interface between the MSC and the MSC. See ANSI-41

Reference Point E₂

Reference Point E₂ is the interface between the MPC and the ESME. See J-STD-036

Reference Point E₃

Reference Point E₃ is the interface between the MPC and the MSC. See J-STD-036

Reference Point E₅

Reference Point E₅ is the interface between the MPC and the PDE. See J-STD-036

Reference Point E₉

Reference Point E₉ is the interface between the MPC and the SCP. See IS-771

Reference Point E₁₁

Reference Point E₁₁ is the interface between the MPC and the CRDB. See J-STD-036

Reference Point E₁₂

Reference Point E₁₂ is the interface between the MSC and the PDE. See J-STD-036

Reference Point E₇

Reference Point E₇ is the interface between the BS and the LPDE. See J-STD-036

Reference Point e

Reference Point e is the interface between the CF and the DF.

Reference Point F

Reference Point F is the interface between the MSC and the EIR.

Reference Point G

Reference Point G is the interface between the VLR and the VLR.

Reference Point H

Reference Point H is the interface between the HLR and the AC.

Reference Point I

Reference Point I is the interface between the CDIS and the CDGP. The operations supported by this interface are described in ANSI-124.

Reference Point J

Reference Point J is the interface between the CDGP and the CDCP. The operations supported by this interface are described in ANSI-124.

Reference Point K

Reference Point K is the interface between the CDGP and the CDRP. The operations supported by this interface are described in ANSI-124.

Reference Point L

Reserved.

Reference Point M₁

Reference Point M₁ is the interface between the SME and the MC.

Reference Point M₂

Reference Point M₂ is the MC to MC interface. See ANSI-41

Reference Point M₃

Reference Point M₃ is the SME to SME interface. See ANSI-41

Reference Point N

Reference Point N is the interface between the HLR and the MC. See ANSI-41

Reference Point N₁

Reference Point N₁ is the interface between the HLR and the OTAF. See IS-725

Reference Point O₁

Reference Point O₁ is the interface between an MWNE and the OSF.

Reference Point O₂

Reference Point O₂ is the OSF to OSF interface.

Reference Point P_i

Reference Point P_i is the interface between:

- the MSC and the PDN.
- the IWF and the PDN.
- the PDSN and the PDN.
- The HA and the PDN
- the AAA and the HA.
- the AAA to AAA.
- the HA and the PDSN.
- the PDSN and the AAA.

See IS-835

Reference Point Q

Reference Point Q is the interface between the MC and the MSC. See ANSI-41

Reference Point Q₁

Reference Point Q₁ is the interface between the MSC and the OTAF. See IS-725

Reference Point R

Reference Point R is the interface between the TA and the TE2.

Reference Point R_m

Reference Point R_m is the interface between the TE2 and the TAm plus the interface between the TE2 and the MT2.

Reference Point R_v

Reference Point R_v is the interface between the DCE and the TE2.

Reference Point R_x

Reference Point R_x is the interface between the PPDN and the TE2.

Reference Point S

Reference Point S is the interface between the ISDN and the TE1.

Reference Point S_m

Reference Point S_m is the interface between the TE1 and the MT1 plus the interface between the TE1 and the TAm.

Reference Point T₁

Reference Point T₁ is the interface between the MSC and the SCP. See IS-771 and IS-826

Reference Point T₂

Reference Point T₂ is the interface between the HLR and the SCP. See IS-771 and IS-826

Reference Point T₃

Reference Point T₃ is the interface between the IP and the SCP. See IS-771 and IS-826

Reference Point T₄

Reference Point T₄ is the interface between the HLR and the SN. See IS-771 and IS-826

Reference Point T₅

Reference Point T₅ is the interface between the IP and the MSC. See IS-771 and IS-826

Reference Point T₆

Reference Point T₆ is the interface between the MSC and the SN. See IS-771 and IS-826

Reference Point T₇

Reference Point T₇ is the interface between the SCP and the SN. See IS-771 and IS-826

Reference Point T₈

Reference Point T₈ is the interface between the SCP and the SCP. See IS-771 and IS-826

Reference Point T₉

Reference Point T₉ is the interface between the HLR and the IP. See IS-771 and IS-826

Reference Point U_i

Reference Point U_i is the interface between the integrated UIM and a ME.

Reference Point U_m

Reference Point U_m is the interface between the BS and the MS, which corresponds to the air interface.

Reference Point U_r

Reference Point U_r is the interface between the Removable-UIM and an ME.

Reference Point U_v

Reference Point U_v is the interface between the Vehicle and an MS. See IS-788, IS-789, and IS-816

Reference Point V

Reference Point V is the interface between the OTAF and the OTAF.

Reference Point W

Reference Point W is the interface between the DCE and the PSTN.

Reference Point X

Reference Point X is the interface between the CSC and the OTAF. See IS-725

Reference Point Y

Reference Point Y is the interface between a Wireless Network Entity (WNE) and the IWF. See ANSI-634 or IS-658

Reference Point Z

Reference Point Z is the interface between the MSC and the NPDB. See IS-756

Reference Point Z₁

Reference Point Z₁ is the interface between the MSC and the VMS. See ANSI-41

Reference Point Z₂

Reference Point Z₂ is the interface between the HLR and the VMS. See ANSI-41

Reference Point Z₃

Reference Point Z₃ is the interface between the MC and the VMS. See ANSI-41